

ZTL431/ZTL432
COST EFFECTIVE ADJUSTABLE PRECISION SHUNT REGULATOR

Description

The ZTL431 and ZTL432 are three terminal adjustable shunt regulators offering excellent temperature stability and output current handling capability up to 100mA. The output voltage may be set to any chosen voltage between 2.5 and 20 volts by selection of two external divider resistors.

The devices can be used as a replacement for zener diodes in many applications requiring an improvement in zener performance.

The ZTL432 has the same electrical specifications as the ZTL431 but has a different pin out in SOT23 (F-suffix) and SOT23F (FF-suffix).

Both variants are available in 2 grades with initial tolerances of 1% and 0.5% for the A and B grades respectively.

These are functionally equivalent to the TL431/ TL432 except for maximum operation voltage, and have an ambient temperature range of -40 to 125°C as standard.

Features

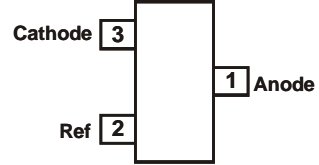
- Temperature range -40 to 125°C
- Reference voltage tolerance at 25°C
 - 0.5%.....B grade
 - 1%A grade
- 0.2Ω typical output impedance
- Sink current capability..... 1mA to 100mA
- Adjustable output voltage.....V_{REF} to 20V

Applications

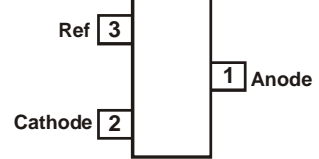
- Opto-coupler linearization
- Linear regulators
- Improved zener
- Variable reference

Pin Assignments

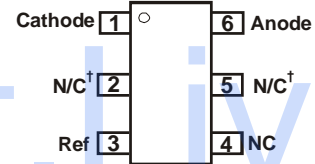
ZTL431_F SOT23, ZTL431_FF SOT23F
(Top View)



ZTL432_F SOT23, ZTL432_FF SOT23F
(Top View)

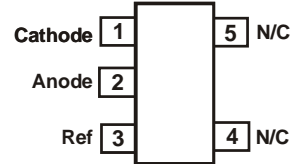


ZTL431_H6, SC70-6
(Top View)

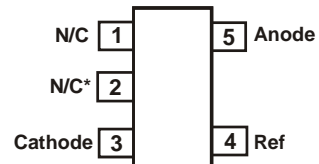


†Connected internally to substrate; should be left floating or connected to Anode

ZTL431ASE5 SOT235
(Top View)



ZTL431_E5 SOT235
(Top View)



*must be left floating or connected to pin 5

Absolute Maximum Ratings (Voltages specified are relative to the ANODE pin unless otherwise stated)

Parameter	Rating	Unit
Cathode Voltage (V_{KA})	20	V
Continuous Cathode Current (I_{KA})	150	mA
Reference Input Current Range (I_{REF})	-50 μ A to 10mA	
Operating Junction Temperature	-40 to 150	$^{\circ}$ C
Storage Temperature	-55 to 150	$^{\circ}$ C

Operation above the absolute maximum rating may cause device failure.
Operation at the absolute maximum ratings, for extended periods, may reduce device reliability.

Package Thermal Data

Package	θ_{JA}	P_{DIS} $T_A = 25^{\circ}$ C, $T_J = 150^{\circ}$ C
SOT23	380 $^{\circ}$ C/W	330 mW
SOT23F	138 $^{\circ}$ C/W	900 mW
SOT23-5	250 $^{\circ}$ C/W	500 mW
SOT70-6	380 $^{\circ}$ C/W	330mW

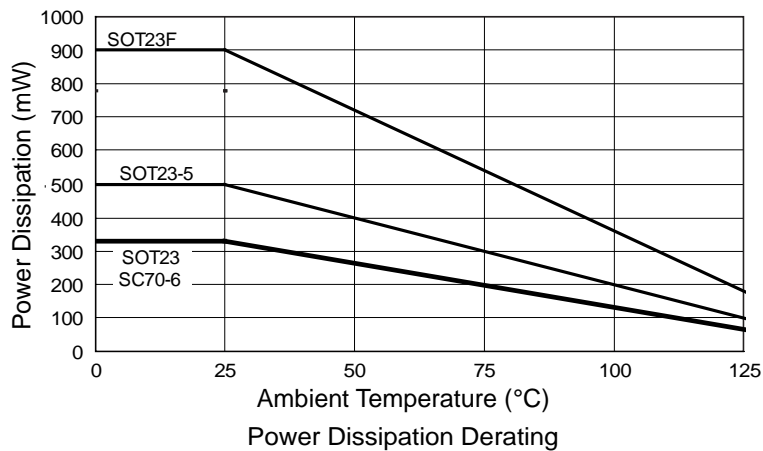
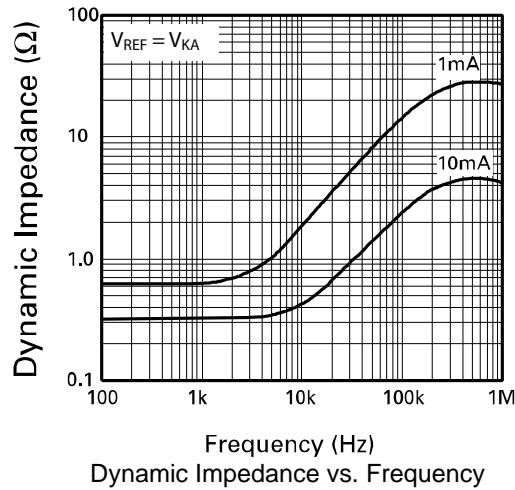
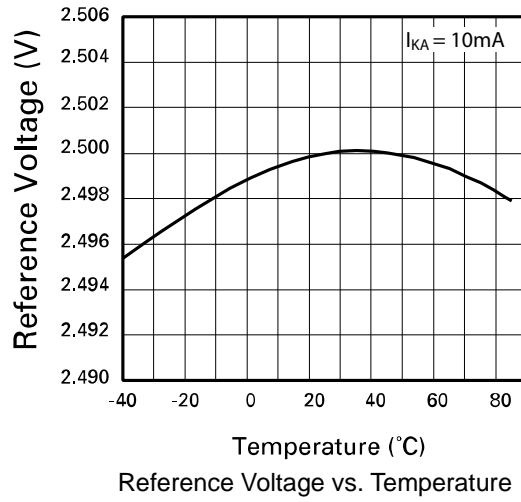
Recommended Operating Conditions

	Min	Max	Units
V_{KA} Cathode Voltage	V_{REF}	20	V
I_{KA} Cathode Current	1	100	mA
T_A Operating Ambient Temperature Range	-40	125	$^{\circ}$ C

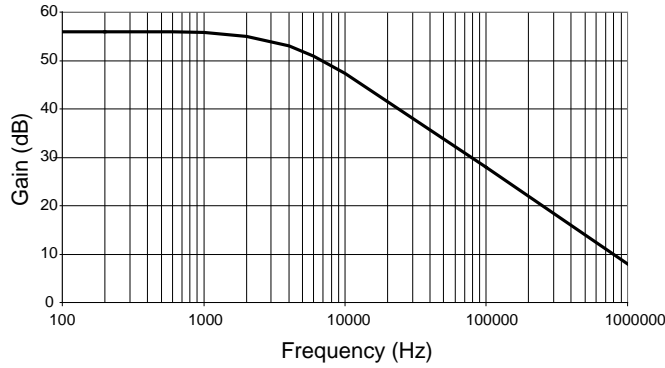
Electrical Characteristics (Test conditions unless otherwise specified: $T_A = 25^{\circ}$ C)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units	
V_{REF}	Reference voltage	$V_{KA} = V_{REF}$ $I_{KA} = 10$ mA	ZTL43_A	2.475	2.5	2.525	V
			ZTL43_B	2.487	2.5	2.513	
V_{DEV}	Deviation of reference voltage over full temperature range	$V_{KA} = V_{REF}$ $I_{KA} = 10$ mA	$T_A = 0$ to 70°		6	16	mV
			$T_A = -40$ to 85° C		14	34	
			$T_A = -40$ to 125° C		14	34	
$\frac{\Delta V_{REF}}{\Delta V_{KA}}$	Ratio of change in reference voltage to the change in cathode voltage	$I_{KA} = 10$ mA	$V_{KA} = V_{REF}$ to 10		-1.4	-2.7	mV/V
			$V_{KA} = 10$ V to 20V		-1.0	-2.0	
I_{REF}	Reference input current	$I_{KA} = 10$ mA, $R_1 = 10$ k Ω $R_2 = OC$		2	4	μ A	
ΔI_{REF}	I_{REF} deviation over full temperature range	$I_{KA} = 10$ mA $R_1 = 10$ k Ω $R_2 = OC$	$T_A = 0$ to 70° C		0.8	1.2	μ A
			$T_A = -40$ to 85° C		0.8	2.5	
			$T_A = -40$ to 125° C		0.8	2.5	
$I_{KA(MIN)}$	Minimum cathode current for regulation	$V_{KA} = V_{REF}$		0.4	0.6	mA	
$I_{KA(OFF)}$	Off state current	$V_{KA} = 20$ V, $V_{REF} = 0$ V		0.1	0.5	μ A	
R_Z	Dynamic output impedance	$V_{KA} = V_{REF}$, $f = 0$ Hz		0.2	0.5	Ω	

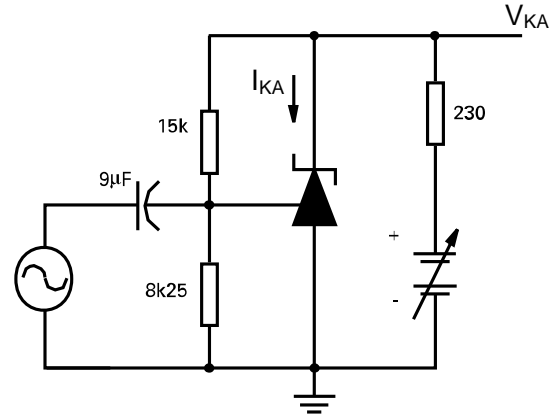
Typical Characteristics



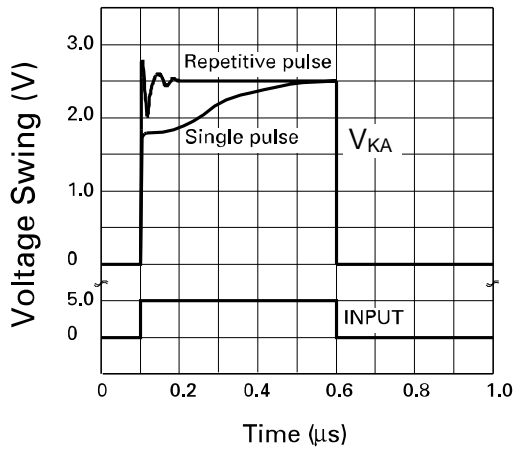
Typical Characteristics (Cont.)



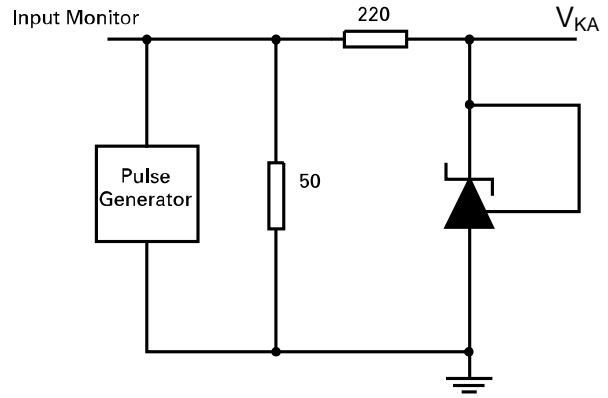
Gain vs. Frequency



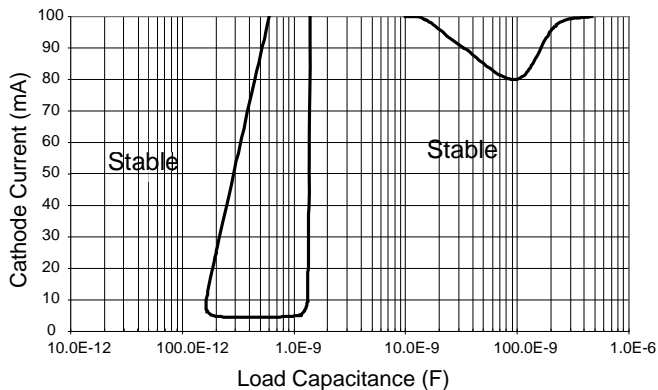
$I_{KA} = 10\text{mA}$, $T_A = 25^\circ\text{C}$
Test Circuit for Open Loop Voltage Gain



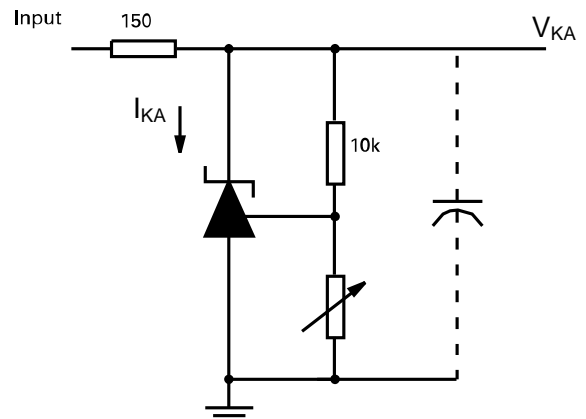
Pulse Response



$T_A = 25^\circ\text{C}$
Test Circuit for Pulse Response

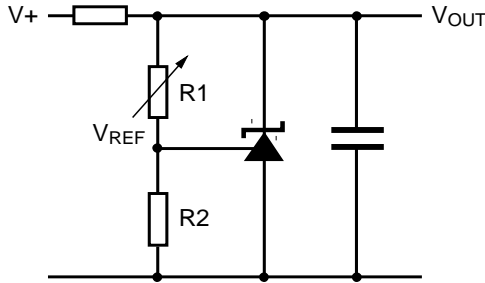


Stability Boundary Condition



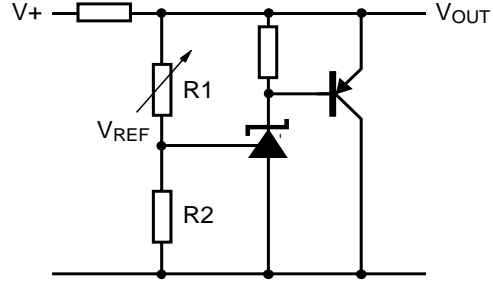
$V_{REF} < V_{KA} < 20$, $I_{KA} = 10\text{mA}$, $T_A = 25^\circ\text{C}$
Test Circuit for Stability Boundary Conditions

Application Circuits



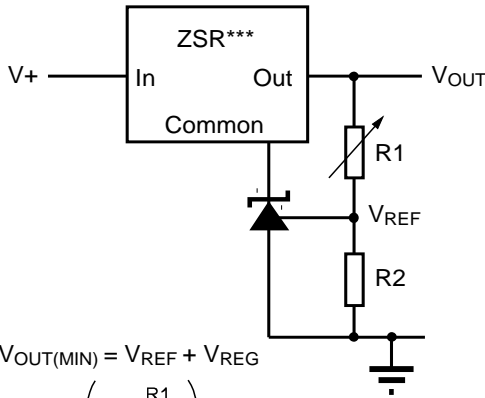
$$V_{OUT} = \left(1 + \frac{R1}{R2}\right) V_{REF}$$

Shunt regulator



$$V_{OUT} = \left(1 + \frac{R1}{R2}\right) V_{REF}$$

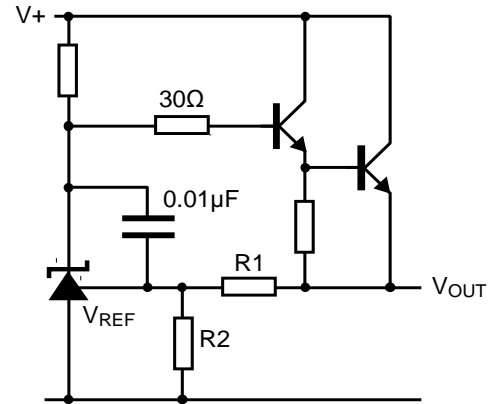
Higher current shunt regulator



$$V_{OUT(MIN)} = V_{REF} + V_{REG}$$

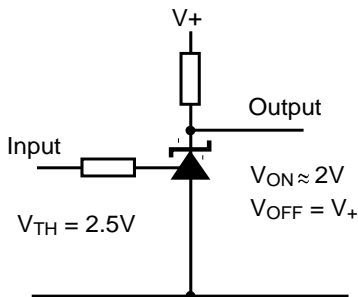
$$V_{OUT} = \left(1 + \frac{R1}{R2}\right) V_{REF}$$

Output control of a three terminal fixed regulator

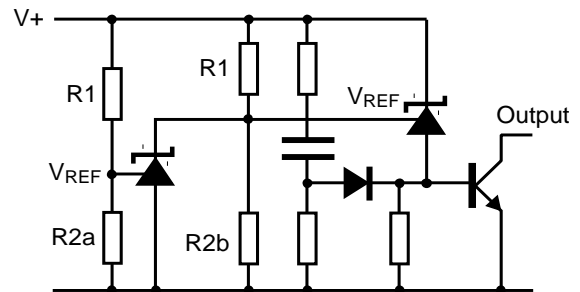


$$V_{OUT} = \left(1 + \frac{R1}{R2}\right) V_{REF}$$

Series regulator



Single supply comparator with temperature compensated threshold



$$\text{Low limit} = \left(1 + \frac{R1B}{R2B}\right) V_{REF}$$

$$\text{High limit} = \left(1 + \frac{R1A}{R2A}\right) V_{REF}$$

Over voltage / under voltage protection circuit

DC Test Circuits

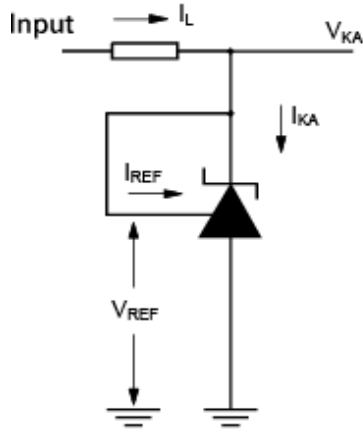


Figure 1. Test circuit for $V_{KA} = V_{REF}$

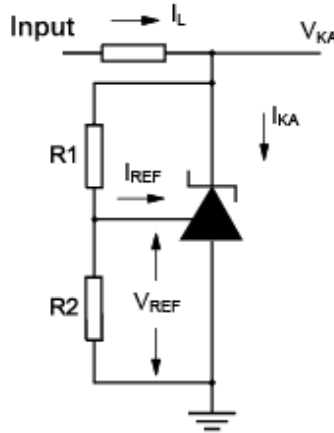


Figure 2. Test circuit for $V_{KA} > V_{REF}$

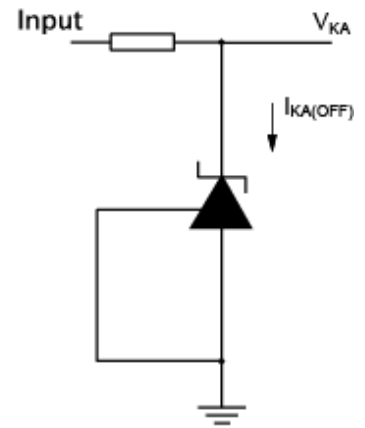


Figure 3. Test circuit for off state current

Notes

Deviation of reference input voltage, V_{dev} , is defined as the maximum variation of the reference input voltage over the full temperature range.

The average temperature coefficient of the reference input voltage, V_{ref} is defined as:

$$V_{REF}(ppm/^{\circ}C) = \frac{V_{DEV} \times 1,000,000}{V_{REF}(T1-T2)}$$

The dynamic output impedance, R_z , is defined as:

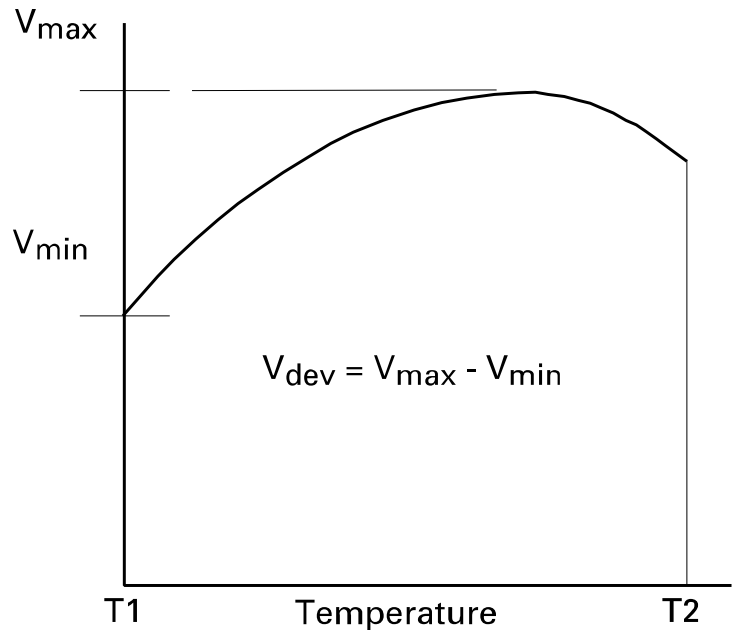
$$R_z = \frac{\Delta V_z}{\Delta I_z}$$

When the device is programmed with two external resistors, R1 and R2, (fig 2), the dynamic output impedance of the overall circuit, R'_z , is defined as:

$$R'_z = R_z \left(1 + \frac{R1}{R2} \right)$$

Stability Boundary

The ZTL431 and ZTL432 are stable with a range of capacitive loads. A zone of instability exists as demonstrated in the typical characteristic graph on page 4. The graph shows typical conditions. To ensure reliable stability a capacitor of 4.7nF or greater is recommended between anode and cathode.

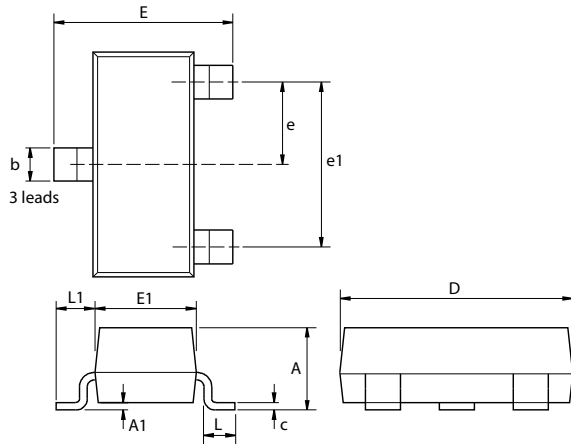


Ordering Information

Tol.	Ordering Code	Pack	Part Mark	Status*	Reel Size	Tape Width (mm)	Quantity per Reel
1%	ZTL431AE5TA	SOT23-5	31A	Active	7", 180mm	8	3000
	ZTL431AFFTA	SOT23F	31A	Active	7", 180mm	8	3000
	ZTL431AFTA	SOT23	31A	Active	7", 180mm	8	3000
	ZTL431AH6TA	SC70-6	31A	Active	7", 180mm	8	3000
	ZTL431ASE5TA	SOT23-5	S2A	Active	7", 180mm	8	3000
	ZTL432AFFTA	SOT23F	32A	Active	7", 180mm	8	3000
0.5%	ZTL432AFTA	SOT23	32A	Active	7", 180mm	8	3000
	ZTL431BE5TA	SOT23-5	31B	Active	7", 180mm	8	3000
	ZTL431BFFTA	SOT23F	31B	Active	7", 180mm	8	3000
	ZTL431BFTA	SOT23	31B	Active	7", 180mm	8	3000
	ZTL431BH6TA	SC70-6	31B	Active	7", 180mm	8	3000
	ZTL432BFFTA	SOT23F	32B	Active	7", 180mm	8	3000
ZTL432BFTA	SOT23	32B	Active	7", 180mm	8	3000	

Package Outline Dimensions

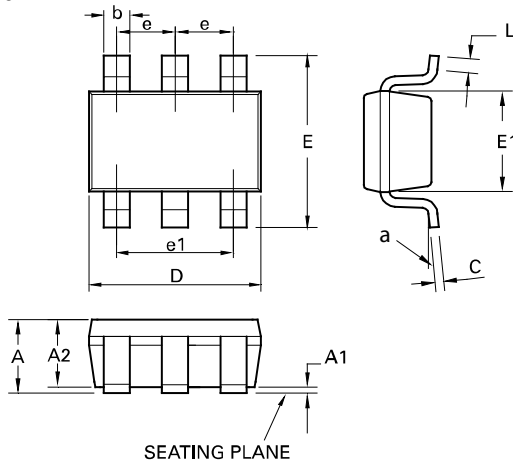
SOT23



Dim.	Millimeters		Inches		Dim.	Millimeters		Inches	
	Min.	Max.	Min.	Max.		Min.	Max.	Max.	Max.
A	-	1.12	-	0.044	e1	1.90 NOM	0.075 NOM		
A1	0.01	0.10	0.0004	0.004	E	2.10	2.64	0.083	0.104
b	0.30	0.50	0.012	0.020	E1	1.20	1.40	0.047	0.055
C	0.085	0.120	0.003	0.008	L	0.25	0.62	0.018	0.024
D	2.80	3.04	0.110	0.120	L1	0.45	0.62	0.018	0.024
e	0.95 NOM		0.0375 NOM		-	-	-	-	-

Note: Controlling dimensions are in millimeters.
Approximate dimensions are provided in inches

SC70-6

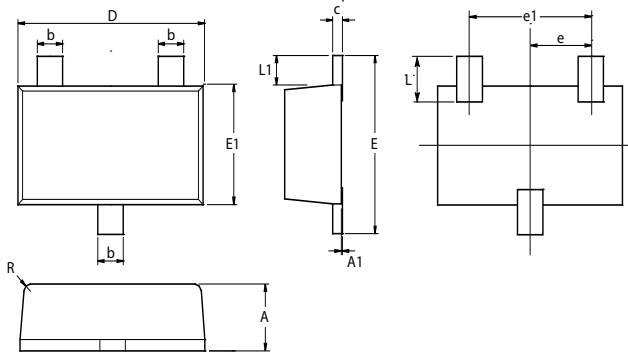


Dim.	Millimeters		Inches		Dim.	Millimeters		Inches	
	Min.	Max.	Min.	Max.		Min.	Max.	Max.	Max.
A	0.80	1.10	0.0315	0.0433	E	2.10 BSC	0.0826 BSC		
A1	-	0.10	-	0.0039	E1	1.25	1.35	0.0492	0.0531
A2	0.80	1.00	0.0315	0.0394	e	0.65 BSC	0.0255 BSC		
b	0.15	0.30	0.006	0.0118	e1	1.30 BSC	0.0511 BSC		
C	0.08	0.25	0.0031	0.0098	L	0.26	0.46	0.0102	0.0181
D	2.00 BSC		0.0787 BSC		a	0°	8°	0°	8°

Note: Controlling dimensions are in millimeters.
Approximate dimensions are provided in inches

Package Outline Dimensions (continued)

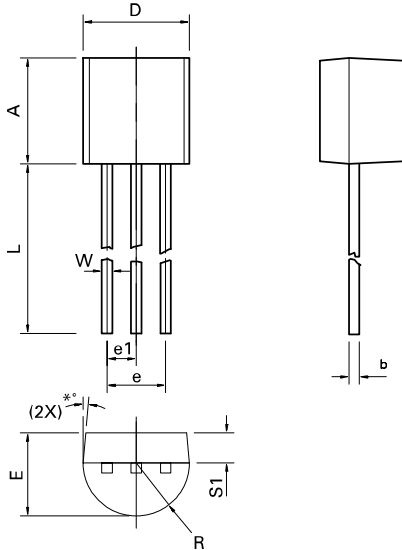
SOT23F



Dim.	Millimeters		Inches		Dim.	Millimeters		Inches	
	Min.	Max.	Min.	Max.		Min.	Max.	Max.	Max.
A	0.80	1.00	0.031	0.0394	E	2.30	2.50	0.0906	0.0984
A1	-	0.10	0.00	0.0043	E1	1.50	1.70	0.0590	0.0669
A2	0.06	0.16	0.0024	0.0006	E2	1.10	1.26	0.0433	0.0496
b	0.39	0.41	0.0153	0.0161	L	0.48	0.68	0.0189	0.0268
c	0.11	0.20	0.0043	0.0079	L1	0.39	0.41	0.0153	0.0161
D	2.80	3.00	0.1102	0.1181	R	0.05	0.15	0.0019	0.0059
e	0.95 ref		0.0374 ref		O	0°	12°	0°	12°
e1	1.90 ref		0.7480 ref		-	-	-	-	-

Note: Controlling dimensions are in millimeters.
Approximate dimensions are provided in inches

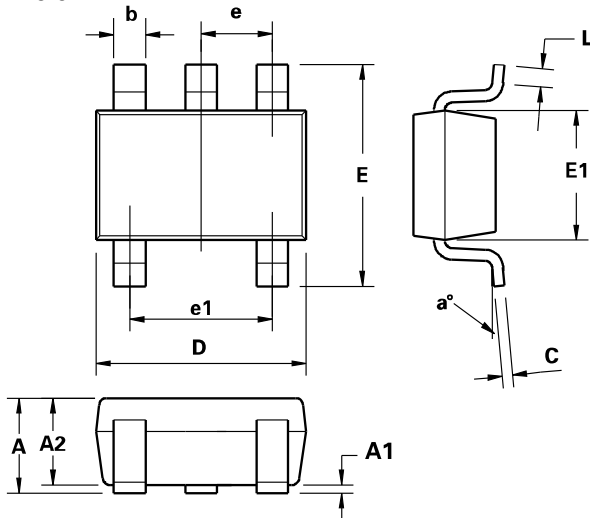
TO92



Dim.	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	4.32	4.95	0.170	0.195
b	0.36	0.51	0.014	0.020
C	2.50	3.50	0.099	0.138
E	3.30	3.94	0.130	0.155
e	4.88	5.88	0.192	0.232
e1	2.44	2.94	0.096	0.116
L	12.70	15.49	0.500	0.610
R	2.16	2.41	0.085	0.095
S1	1.14	1.52	0.045	0.060
W	0.41	0.56	0.016	0.022
D	4.45	4.95	0.175	0.195
*°	4°	6°	4°	6°

Note: Controlling dimensions are in millimeters.
Approximate dimensions are provided in inches

SOT23-5



Dim.	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	0.90	1.45	0.0354	0.0570
A1	0.00	0.15	0.00	0.0059
A2	0.90	1.30	0.0354	0.0511
b	0.20	0.50	0.0078	0.0196
C	0.09	0.26	0.0035	0.0102
D	2.70	3.10	0.1062	0.1220
E	2.20	3.20	0.0866	0.1181
E1	1.30	1.80	0.0511	0.0708
e	0.95 REF		0.0374 REF	
e1	1.90 REF		0.0748 REF	
L	0.10	0.60	0.0039	0.0236
a°	0°	30°	0°	30°

Note: Controlling dimensions are in millimeters.
Approximate dimensions are provided in inches

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